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ABSTRACT

This report uses mental model theory to create a taxonomy of picture functions in order to relate these functions to learning theories. A rough outline of picture functions is presented, consisting of a retrieval function, a focus function, a construction function, and a supplantation function. It is suggested that this taxonomy could be helpful in elaborating a "grammar of pictures" since pictures may have to be designed differently according to their intended function. It is recommended that prescriptive hypotheses based on this taxonomy be created and tested empirically. (8 references) (EW)

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Learning with pictures
A taxonomy of picture functions based on mental model theory

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The problem with common taxonomies of picture functions lies in their indistinct relation to a theory of learning processes. As a result, we meet a wide variety of taxonomies including different picture roles and functions. Here are some examples. Duchastel (1978) differentiates between attentional, explicative, and retentional roles of illustrations. Levie and Lentz (1982) present a list including attentional, affective, cognitive, and compensatory functions. Levin (1981),and Levin et al. (in press) speak of a decorative, representation, organization, interpretation, and transformation function. Issing (1983) describes a motivation, information, reinforcement, communication, guidance, explanation, memory, diagnosis, and therapy function of pictures.

An analytic inspection of such taxonomies reveals an unsatisfactory disorder in theoretical orientation. Some of the picture functions show an instructional perspective, others are formulated from a structural view at the relationship between picture and text, and few refer to cognitive and other processes within the learner. Instruction-oriented is, for example, the compensatory function (Levie & Lentz, 1982), which means that pictures can accomodate poor readers. Related to a structural view of the learning situation are, for example, the attentional, decorative, organization functions, as the above mentioned authors refer them to the "service function" of the picture to the understanding of text. Only few picture functions can be read as focussing at the learning process directly, i.e., at the learner and his/her activities. These are, for example, the functions mentioned by Levin et al. (in press), if one does not interpret them (as the authors do) in respect to the learning of text, but in respect to cognitive learning processes in general. An "organizational picture" can be seen as a picture helping the learner find a cognitive frame to integrate new informations in a meaningful way. Similarly, the memory, explanation, and other functions can be interpreted from a learner-oriented perspective.

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To overcome the disparate theoretical dimensions in the common taxonomies of picture functions, research should favour an analysis of picture effects strictly in terms of learner variables. This leads to the necessity of an adequate theory of learning processes, which could serve as a base for the development of a learner-oriented taxonomy of picture functions.

Mental model theory is an influencing attempt to model and explain understanding of such different objectives and materials as texts, machines, logical reasoning, scientific laws, and technical procedures (Johnson-Laird, 1983; Gentner & Stevens, 1983). In short, understanding is analyzed as the construction, evaluation, and use of mental models, i.e., representations of the target space, which are characterized by a considerable amount of coherence, concreteness, and adequacy in respect to the topic at hand. As understanding is the central aim of instruction,as well as the most important condition for success in learning tests, the mental model approach could serve as a promising approach for the analysis of learning with pictures, too.

Pictures now can be analyzed in respect to functions they serve in supporting the learner to construct an adequate mental model and to use it effectively. Of course, each function depends on the interaction between learner variables, the learning situation, the task, and the picture. Nevertheless, we can describe picture functions post-hoc as typical patterns of such interactions which led to a learning effect.

A taxonomy of picture functions developed from mental model theory can be arranged along a dimension of intensity, with which the picture defines the mental model of the learner. As a stimulus for discussion, we present in a rough sketch the following picture functions:

* Retrieval function: Pictures can activate a mental model already elaborated by the learner and stored in his/her memory system.

* Focus function: Pictures can draw attention to a detail of a mental model, already available by the learner. This function can produce specific modifications of the learner's mental model.
* Construction function: Pictures can help the learner to construct an adequate mental model in two ways. First, they can yield material, i.e. informations about the learning content, for example visible attributes. Second, they can offer operational devices, how diverse informations may be connected and structured in a meaningful way.
* Supplantation function: Pictures can present an elaborated mental model to be taken over by the learner's cognitive system. Then, the mental model of the picture's designer will correspond distinctively to the mental model of the learner after having processed the picture. The supplantation function can be realized if a learner fails to develop a mental model by him/herself.

This taxonomy could be helpful in elaborating a "grammar of pictures" (Duchastel & Waller, 1979), because pictures may have to be designed differently according to their intented function. For retrieval function, a picture should contain strong retrieval cues; realistic details can be neglected, as, for example, in a pictogram. In order to fulfil the focus function, a picture should accentuate optically the critical details. Similar prescriptive hypotheses can be created for the other functions and should be tested empirically.

In sum, mental model theory could prove fruitful for the picture research in the field of learning and instruction.

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